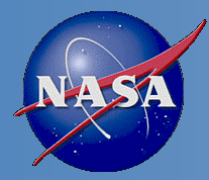


S-NPP VIIRS Land SIPS: Forward Processing and Reprocessing Plan

Sadashiva Devadiga^{1,2}, Carol Davidson^{1,2}, Gang Ye^{1,2}, Miguel Román¹, and Ed Masuoka¹

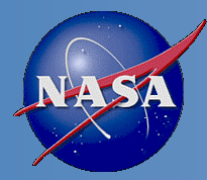
¹NASA Goddard Space Flight Center, ²Science Systems and Applications Inc.



Outline



- **MODIS C6 Reprocessing Status**
- **VIIRS Land Processing Streams**
 - Forward Processing (AS 3002)
 - C11 Reprocessing (AS 3110)
 - V1 Processing (AS 5000)
- **V1 Processing and Reprocessing Plan**
 - L1B and Geolocation
 - Using IDPS L1B and NASA L1B
 - Land Product Delivery Schedule
 - Metadata Requirement



MODIS C6 Reprocessing Status



- **Teir1 Block of Products**

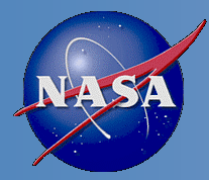
- Reprocessing of Land Surface Reflectance (MxD09), Vegetation Index (MxD13), LAI/FPAR (MxD15), GPP(MxD17), Sea-Ice (MxD29), and Active Fire (MxD14) started in Feb 2015 and completed in Jan 2016. Forward processing of these products started in Jan 2016. These data have been released to public.
- Reprocessing of BRDF-Albedo (MCD43) and Land Surface Temperature (MxD11) products expected to complete in August 2016.

- **Teir2 Block of Products**

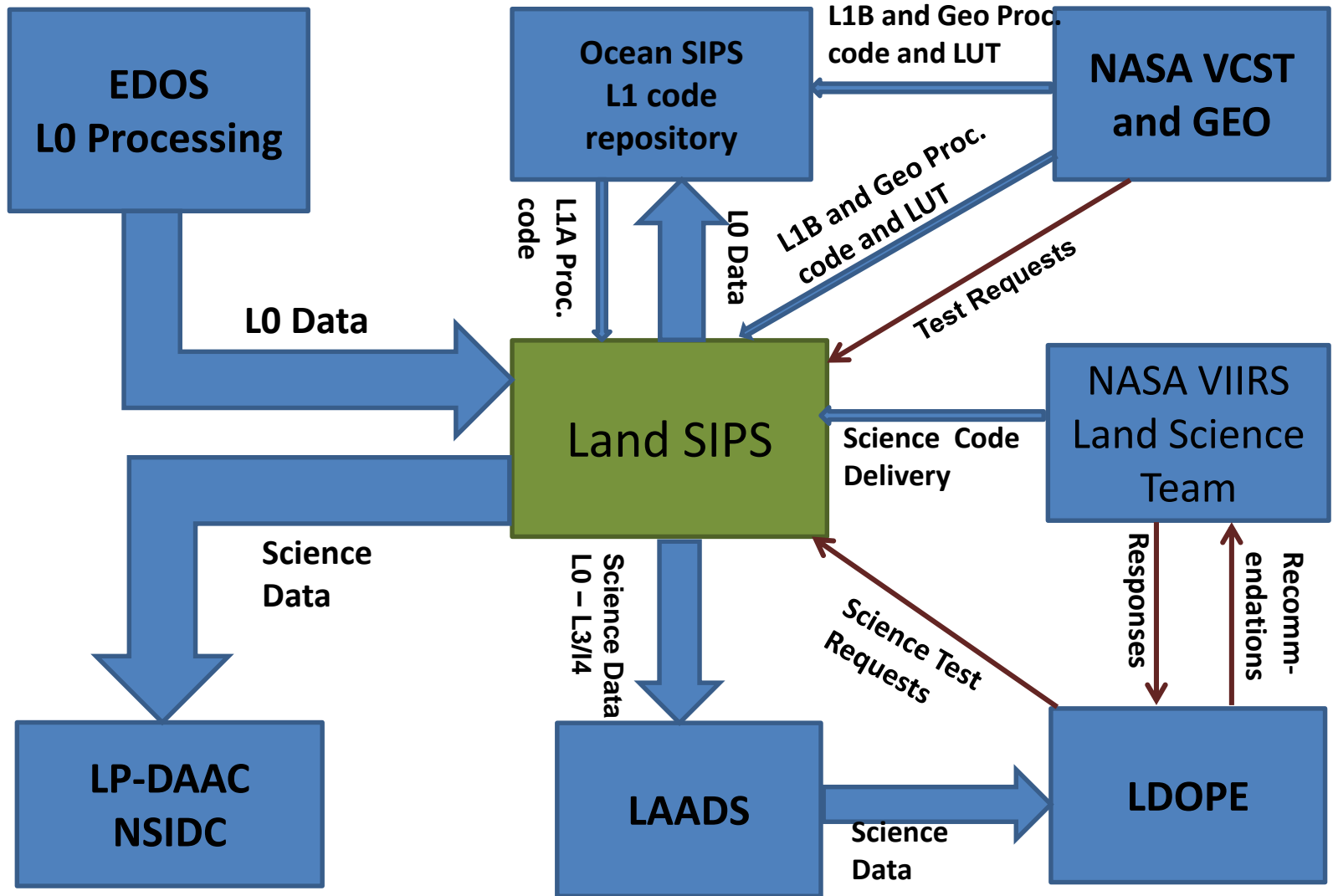
- Reprocessing of Snow (MxD10) expected to complete by mid June 2016. Forward processing started in Jan 2016.
- Evapotranspiration (MxD16) and VCF (MOD44B) ready for reprocessing.
- C6 Algorithm changes for MAIAC (MCD19), LST (MxD21) from JPL, Burned Area (MCD64A1), Land Cover (MCD12Q1), Land Cover Dynamics (MCD12Q2), Daily Radiation and PAR (MCD18), are currently under development and science testing.

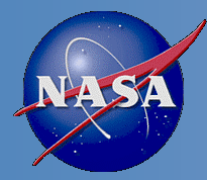
- **C5 processing to continue until late 2016 or Spring 2017.**

- **Products from the C5 processing are expected to be available from DAAC for a year after completion of the C6 land reprocessing.**



Operational Interface



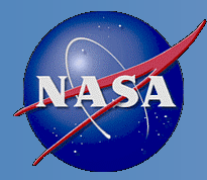


VIIRS Land Processing Streams

**Forward Processing (AS 3002): NASA L1, IDPS L1B/Geo SDR, IDPS Mx8.11
Build, 5min granules, HDF4/HDF4-EOS, Retention: 30 day**



- Generates the VIIRS Land L1B SDRs, L2 swath products (IPs and EDRs) using mix of IDPS OPS PGEs, Land SIPS adjusted version of IDPS OPS PGEs. L3 gridded products generated using the Land SIPS DDR algorithms.
- L1B SDRs are generated from processing of NASA L1A using the IDPS SDR calibration algorithm. (Melded IDPS LUT – variation to replace IDPS RSB Auto Cal)
- Processing of data prior to April 1, 2016 used IDPS RDRs aggregated to ~5min granules. Since then Land SIPS processing has been using the 5min size granules of NASA L1A generated from the NASA L0 data.
- Products were generated using incremental build versions of algorithm used at IDPS, with the Mx8.11 version installed at Land SIPS on March 4, 2016. Land SIPS will not install any future IDPS algorithm revisions.
- Products are generated in HDF4/HDF4-EOS format and are available to public from AS 3002 of LAADS. Most L2 and L3 daily products have retention period of 30 days. Some L3 daily and n-day products may be available from longer mission period.
- Following products discontinued – NOAA EDRs: global albedo, VI, Active Fire and Snow Cover Density, 16-day BRDF-Albedo DDR,
- Product will be discontinued in this AS upon request by the PI or the heritage process is in operation in AS 5000 and is not required by any downstream in the AS.

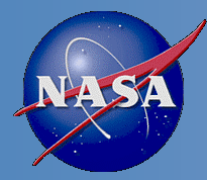


VIIRS Land Processing Streams

C11 Reprocessing (AS 3110): IDPS RDRs, L1B/Geo SDR, IDPS Mx7.2 Build, 5min aggregated granules, HDF4/HDF4-EOS, Retention: Permanent



- **Generated consistent VIIRS land data records covering the mission period, beginning with Feb 19, 2012 through Jan 31, 2016, using the best of calibration algorithm, LUT and science algorithms.**
- **Includes L1B SDRs, L1/L2 swath products (IPs and EDRs) generated using the Mx7.2 based IDPS OPS algorithms and Land SIPS variation of the IDPS algorithms. L3 daily and n-day tiled products generated using the DDR algorithms based on the C5/C6 MODIS L2G/L3 algorithms.**
- **L1B SDRs used the calibration LUTs provided by the NASA VCST.**
- **DNB processed using the LUT for calibration and stray light correction provided by the NASA VCST.**
- **Cloud Mask used the Climatology 16-day composite NDVI from the 4-years of Aqua MODIS observations and daily NISE data as seed input for NBAR-NDVI and daily snow-ice.**
- **Following products not available – global albedo EDR, 16-day BRDF-Albedo DDR,**
- **Products are in HDF4/HDF4-EOS format and is available to public from AS 3110 of LAADS.**
- **Product will be discontinued in this AS upon request by the PI or the heritage product is available for the mission period in AS 5000**

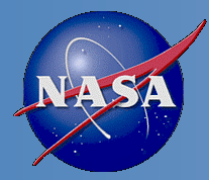


VIIRS Land Processing Streams

**V1 Processing (AS 5000): NASA L1, L1B/Geo, L2/L3, 6min granules,
HDF5/HDF5-EOS, Retention: Permanent**



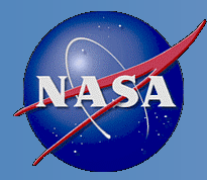
- **Generate MODIS heritage VIIRS products proposed by the NASA VIIRS science team using the NASA science team delivered algorithms.**
- **L1B is generated by processing the NASA L1A using either the IDPS SDR/Geo algorithm or the NASA calibration algorithm using the L1B LUTs provided by the NASA VCST.**
- **Uses IDPS algorithms for AOTIP (with changes from LSR PI) and Cloud Mask (Use NISE and MODIS Climatology NDVI). May switch to use MVCMM with approval from Land Science Team.**
- **L2 and L3 products are generated using the NASA science team delivered algorithms.**
- **Science team delivered algorithms are used in the V1 forward processing and reprocessing when they are approved by the science teams.**
- **L1/L2 products are in netcdf4/HDF5 and L3/L4 products are in HDF5-EOS format and are in 6-min granule size (*details in the next presentation by Carol Davidson*)**
- **All L3 products are produced as 10 deg tiles in Sinusoidal map projection except for Ice products produced in polar projection (*should we make in lat/long projection – presentation by Nima Pahlevan*)**
- **Products are available to public from LP-DAAC, NSIDC and from LAADS.**



Summary of Three ASs



Processing stream and LAADS AS	C11 Reprocessing AS 3110	Forward Processing AS 3002	V1 Forward processing and Reprocessing AS 5000
What is the current data day being processed?	Last data day Jan 31, 2016.	Leading edge a day behind current data day	Leading edge a day behind current data day
What mission period the data available?	Feb 19, 2012 – Jan 31, 2016	L2: last 30 days L3: most available for the mission period.	Expected to be available for the mission period
Are products available from DAACs	No	No	Yes
L1B Calibration Algorithm version?	IDPS L1B SDR Mx7.2 + L1B LUT from NASA VCST	IDPS L1B SDR Mx8.11 + IDPS SDR Melded LUT (IDPS uses RSB Auto Cal)	NASA L1B V2.0 + L1B LUT from NASA VCST
L1B/L2 Granule size?	Aggregated ~5min from IDPS verified RDR	5 min from NASA L1A/L0	6 min from NASA L1A/L0
L2/L3 Algorithm versions?	IDPS Mx7.2 + LPA	IDPS Mx8.11 + LPA	NASA V1 / V2 algorithms
File format	HDF4/HDF4-EOS	HDF4/HDF4-EOS	HDF5/HDF5-EOS (if distributed from DAACs)

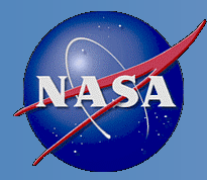


V1 Forward Processing and Reprocessing Plan

L1B (VNP02) and Geolocation (VNP03)



- **Operational L1B and Geolocation product for archive and distribution is to be generated using the V2.0 version of the NASA Calibration (PGE 502) and Geo process.**
 - To be delivered around mid June 2016
 - Sample products from V1.1 version delivered in Feb 2016 available from AS 1 of Land SIPS
 - No significant change to TOA reflectance or radiance
 - multiple fill values (bow-tie deletion, data loss, uncalibrated)
 - Uncertainty index dataset (one byte dataset per band including DNB)
 - Change in calibration to handle single pixel false fire

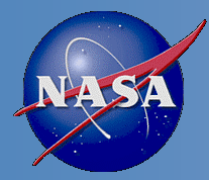


V1 Forward Processing and Reprocessing Plan

Using IDPS L1B and NASA L1B



- **L1B records produced using the current IDPS operational process (Mx8.11 of PGE302) and NASA VCST's Calibration Algorithm (PGE 502) will produce comparable outputs from processing of the NASA L1A using the LUT provided by NASA VCST.**
 - Both will generate 6min granules, there are difference is file spec.
 - PGE302 output is in HDF4, PGE502 out is in HDF5
- **Processing scenario in AS 5000 prior to and after installation of V2.0 NASA L1B/Geo**
 - **Scenario1: Land SIPS will generate the Land Products using the L1B and Geolocation product generated using PGE302 with LUT provided by the NASA VCST**
 - **Scenario2: Land SIPS will transition to use L1B generated using the NASA Approach (PGE 502) after all required changes are implemented in the V2.0 version of the L1B and land science team have approved use of the NASA L1B.**
 - **Only the L1B and Geo generated using the NASA Calibration Approach (Scenario 2) will be archived and distributed.**
 - **Land Product from both scenario1 and scenario2 could be distributed from LP-DAAC if the product is in HDF5 format and meets the metadata requirement, else product may only be distributed from LAADS.**
- **Reprocessing of Surface Reflectance and Fire started with Jan 2015. Currently using the scenario 1, i.e. L1B and Geolocation generated using the IDPS SDR/Geo process. Will start processing from the beginning of the mission after catching to current data day in the forward processing.**
- **V1 Forward Processing of a product suite can start with the current data day when a PGE is approved for processing. Reprocessing can either follow the surface reflectance schedule or could start from the beginning of the mission.**
 - **If your product scheduled (see next slide) for delivery after June 2016 plan for NASA L1B as input**



V1 Forward Processing and Reprocessing Plan

Scenario1 (IDPS L1B) vs Scenario2 (NASA L1B)



Scenario 1

NASA L0

Scenario 2

NASA L1A
PGE 500

IDPS L1B SDR/GEO
PGE 302

NASA L1A/Geo
PGE 501

NASA L1B SDR
PGE 502 v2.0

L2 LSR
PGE 511

L2 Fire
PGE 530

L2 Snow
PGE 507

L2 LSR
PGE 511

L2 Fire
PGE 530

L2 Snow
PGE 507

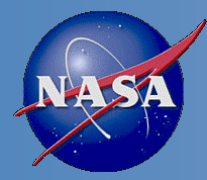
L2G Pointer/Angle
PGE 512

L2G Pointer/Angle
PGE 512

L2G Heavy
PGE513

L2G Lite
PGE517

L3 PGEs

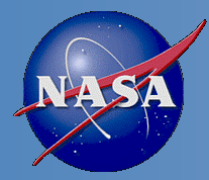


V1 Forward Processing and Reprocessing Plan

L2, L2G and L3 Product development



- **L2 products: Input IDPS L1B vs NASA L1B**
 - Prepare to deliver for NASA L1B which is in netcdf4/HDF5 format. Significant reworking of L2 code may be required to transition from using the IDPS L1B SDR (HDF4) to NASA V2.0 L1B (HDF5)
 - There is no QA bit flagging the L1B reflectance/radiance as good or poor in the NASA L1B. L2 science algorithms will have to make a collective decision at pixel level based on pixel level and scan level QA flags provided in the L1B and geolocation.
 - Overflow, Out of range, saturation etc. situations will have some value – not a fill as in MODIS L1B.
 - Anomaly in L1B may not necessarily mean poor – e.g. dual gain anomaly
- **L2G products**
 - Most L2G development done at Land SIPS/LDOPE.
 - L2G pointer and L2G-heavy will be in HDF4-EOS. L2G-lite is in HDF5-EOS
- **L3 products**
 - Know your input: L2G or L2G-lite ? Operational L2G and L2G-lite Surface Reflectance is now available from AS 5000
 - Projection and Resolution: Confirm that L2G is available. E.g. Moderate resolution resampled gridded to 1km or 500m.

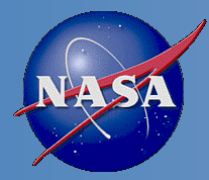


V1 Forward Processing and Reprocessing: Schedule

Land Products: Schedule and Status



Product Name and ESDT series	Heritage MODIS	Product Status	Product Availability
Surface Reflectance VNP09	MxD09	Science code delivered and transitioned to operations	Jun 2016
LAI/FPAR VNP15	MxD15	Science code delivered and undergoing testing	June 16
Snow Products VNP10	MxD10	Science code delivered and undergoing testing	June 16
MAIAC VNP19	MCD19	Science code under development at SCF	July 2016
BRDF/Albedo VNP43	MCD43	Science code delivered and undergoing testing	June 2016
Burned Area VNP64A1	MCD64A1	Science code under development at SCF	March 2017
Active Fires VNP14	MxD14	Science code delivered and transitioned to operations	June 2016
Vegetation Index VNP13	MxD13	Science code under development at SCF	August 2016
LST & E VNP11(VNP21)	MxD11 (MxD21)	Science code delivered and undergoing testing	Dec 2016
Ice Products VNP29/VNP30	MxD29	Science code under development at SCF	Nov 2016
Phenology VNP12Q2	MCD12Q2	Science code under development at SCF	Apr 2017
Day Night Band VNP39	None	Science code delivered and undergoing testing	Apr 2017



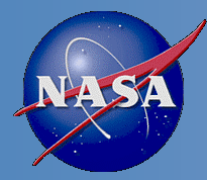
V1 Forward Processing and Reprocessing: Schedule

Land Products: Product Resolution



Product Name and ESDT series	Heritage MODIS	L2G / Level 3 / CMG Products Proposed by the Science Teams							
		375m (10° tile)	500m (10° tile)	750m (10° tile)	1 km (10° tile)	4km (10° tile)	10 km (10°tile)	1km (CMG)	5km (CMG)
Surface Reflectance VNP09	MxD09		✓		✓				✓
LAI/FPAR VNP15	MxD15		✓						
Snow Products VNP10	MxD10	✓							✓
MAIAC VNP19	MCD19		✓		✓		✓		
BRDF/Albedo VNP43	MCD43		✓		✓			✓	✓
Burned Area VNP64A1	MCD64A1		✓*						
Active Fires VNP14	MxD14				✓				
Vegetation Index VNP13	MxD13		✓		✓				✓
LST & E VNP11	MxD11 (MxD21)				✓				
Ice Products VNP29/VNP30	MxD29	✓**		✓**		✓**			✓
Phenology VNP12Q2	MCD12Q2		✓						✓
Day Night Band VNP39	None		✓					✓	

** : polar projection



Metadata

Ideal: Same or Similar as in Heritage MODIS



- Archive

- LOCALGRANULEID
- PRODUCTIONDATETIME
- DAYNIGHTFLAG
- ORBITNUMBER
- GRANULENUMBER
- SHORTNAME
- LONGNAME
- SENSORSHORTNAME
- PLATFORMSHORTNAME
- EQUATORCROSSINGDATE
- EQUATORCROSSINGTIME
- EQUATORCROSSINGLONGITUDE
- EQUATORCROSSINGLATITUDE
- GRINGPOINTLONGITUDE
- GRINGPOINTLATITUDE
- NORTHBOUNDINGCOORDINATES
- SOUTHBOUNDINGCOORDINATES
- EASTBOUNDINGCOORDINATES
- WESTBOUNDINGCOORDINATES
- TILEID
- HORIZONTALTILENUMBER
- VERTICALTILENUMBER
- DATARESOLUTION
- PROCESSINGCENTER
- RANGEBEGINNINGDATE
- RANGEBEGINNINGTIME
- RANGEENDINGDATE
- RANGEENDINGTIME

- Data Identification

- Creator_email
- Creator_name
- Creator_url
- Naming_authority
- Publisher_email
- Publisher_name
- Publisher_url
- Product_doi
- Product_authority

Quality

Generic

SCIENCEQUALITYFLAG
SCIENCEQUALITYFLAGEXPLANATION
PERCENTLAND
PERCENTWATER
PERCENTCLOUD
QAPERCENTGOODQUALITY
QAPERCENTOTHERQUALITY
QAPERCENTNOTPRODUCED

Specific

- Provenance/Processing History

- PGNUMBER
- PGEVERSION
- INPUTPOINTER
- ANCILLARYINPUTPOINTER
- DAYNUMBERS
- PROCESSINGENVIRONMENT
- VERSIONID